

Choose the best answer from the choices (5 points each)

1) The net ionic equation for formation of an aqueous solution of NiI_2 accompanied by evolution of CO_2 gas via mixing solid NiCO_3 and aqueous hydriodic acid is

_____.

- (a) $2\text{NiCO}_3 (\text{s}) + \text{HI} (\text{aq}) \rightarrow 2 \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g}) + 2\text{Ni}^{2+} (\text{aq})$
- (b) $\text{NiCO}_3 (\text{s}) + \text{I}^- (\text{aq}) \rightarrow 2 \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g}) + \text{Ni}^{2+} (\text{aq}) + \text{HI} (\text{aq})$
- (c) $\text{NiCO}_3 (\text{s}) + 2\text{HI} (\text{aq}) \rightarrow 2 \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g}) + \text{NiI}_2 (\text{aq})$
- (d) $\text{NiCO}_3 (\text{s}) + 2\text{H}^+ (\text{aq}) \rightarrow \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g}) + \text{Ni}^{2+} (\text{aq})$**
- (e) $\text{NiCO}_3 (\text{s}) + 2\text{HI} (\text{aq}) \rightarrow \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g}) + \text{Ni}^{2+} (\text{aq}) + 2 \text{I}^- (\text{aq})$
- (f) None of the above

2. Which of the following are strong electrolytes?

- (a) hydroiodic acid (d) acetic acid **(g) a, b, c** (j) b and c
- (b) sodium hydroxide (e) chlorous acid (h) a, b, c and e
- (c) ammonium chloride (f) all of the above (i) none of the above

3. How many milliliters of a 4.2 M solution of ammonium sulfate must be added to water to make 2.0 liters of a 0.20 M solution of ammonium sulfate.

- (a) 48 mL (c) 200 mL (e) 42 mL (g) none of the above.
- (b) 95 mL** (d) 400 mL (f) 420 mL

4. Which one of the following solutions will give the most strongly basic solution (assume complete solubility of all species)?

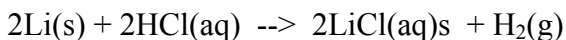
- (a) 100 mL of 0.2 M sulfuric acid solution added to 50 mL of a 0.5 M magnesium hydroxide solution
- (b) 150 mL of a 0.2 M hydrochloric acid solution added to 50 mL of a 0.5 M magnesium hydroxide solution
- (c) 100 mL of 0.3 M ammonia added to 50 mL of a 1.6 M sodium hydroxide**
- (d) 0.025 M beryllium hydroxide
- (e) 0.100 M hydrochloric acid
- (f) None will produce hydroxide ions

5. How many grams of sodium bicarbonate must be added to make 1 L of a 1.5 M solution?

- (a) 107 g **(c) 126. g** (e) 168 g (g) none of the above

- (a) 252 (c) 378 (e) 126 (g) 720 (i) 7.8
(b) **63** (d) 15.6 (f) 680 (h) 232

12. 13.9 g of lithium metal is reacted with excess hydrochloric acid to produce Hydrogen gas and lithium ions. Calculate the amount of work done by the reaction. Assume that 22.4 L of hydrogen is produced for every mole and the pressure is 1 atm.



- | | | | |
|------------------------|-----------------|-----------------|-----------------|
| (a) -22.4 L-atm | (c) -66.8 L-atm | (e) -11.2 L-atm | (g) -44.8 L-atm |
| (b) -44.8 L-atm | (d) -14 L-atm | (f) 22.4 L-atm | (h) -66.8 L-atm |

13. The frequency of green light is approximately $6 \times 10^{14} \text{ s}^{-1}$ and the frequency of violet light is approximately $7.5 \times 10^{14} \text{ s}^{-1}$. How many photons of violet light have the same total energy as 10 photons of green light?

- | | | | | |
|-------|-------|-------|--------------|--------|
| (a) 1 | (c) 3 | (e) 5 | (g) 7 | (i) 9 |
| (b) 2 | (d) 4 | (f) 6 | (h) 8 | (j) 10 |

14. Put the following forms of electromagnetic radiation in the order of their frequency from lowest to highest:

X-rays, radio waves, ultraviolet radiation, infrared radiation, visible light.

- (a) visible, infrared, ultraviolet, X-rays, radio waves
- (b) infrared, visible, ultraviolet, X-rays, radio waves
- (c) infrared, ultraviolet, visible, X-rays, radio waves
- (d) radio waves, infrared, visible, ultraviolet, X-rays**
- (e) X-rays, ultraviolet, visible, infrared, radio waves

15. Electron microscopy involves imaging of objects on a very small scale using a beam of electrons. It demonstrates which of the following phenomenon

- (a) The photo-electric effect
- (b) The Debrogle wave/partical duality**
- (c.) The existance of the nucleus
- (d) Black body radiation
- (e) The quantization of light energy
- (f) The fact that energy is a state function

16. Which of the following experiments demonstrated the existence of the nucleus?

- (a) J. J. Thompson's cathode ray tube and mass spectroscopy
- (b) Muliken's oil drop experiment
- (c) The photo electric effect.
- (d) The Rutherford gold foil experiment**
- (e) The discovery of radium

17. Standing waves have certain properties that make them good models for electrons bound to atoms. Which of the following represent those properties:

- (a) The frequency of a standing wave is quantized
- (b) The wave-like nature of electrons make it possible to describe them as standing waves.
- (c) The wavelength of a standing wave is quantized.
- (d) The energy of the standing wave of an electron can be quantized using the DeBroglie hypothesis.
- (e) None of the above
- (f.) All of the above**

18. Which of the following represent allowed values of the four quantum numbers, n , l , m_l , m_s ?

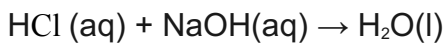
- (a) 2, 0, -1, $\frac{1}{2}$
- (b) 1, 2, -1, $\frac{1}{2}$
- (c) 2, 2, 2, $\frac{1}{2}$
- (d) 1, 1, 1, $\frac{1}{2}$
- (e) 2, 1, -1, $\frac{1}{2}$**
- (f) 3, 3, -1, $\frac{1}{2}$

19. (15 points) From the following thermochemical equations, calculate the enthalpy of formation of CH₄



-75 kJ

20. (15 points) The following acid-base reaction is performed in a coffee cup calorimeter:



The temperature of 110 g of the solution rises from 25.0°C to 26.2°C when 0.10 mol of HCl is reacted with 0.10 mol of NaOH (assume the specific heat of the solution to be 4.184 J/Kg).

- Calculate q_{water}
- **550 J**
- Calculate ΔH for the reaction
- **-5.5 kJ**
- Calculate ΔH if 1.00 mol NaOH reacts with 1.00 mol HCl

-5.5 kJ

21. (15 points) Draw diagrams of the following orbitals (what the orbitals *look like in space*):

a. a 1s and 2s orbital

b. A $2p_y$ and $2p_x$ orbital

c. Three of the five 3d orbitals

Metal	Oxidation Reaction				
Lithium	$\text{Li}(s)$	$\longrightarrow$	$\text{Li}^+(aq)$	+	e^-
Potassium	$\text{K}(s)$	$\longrightarrow$	$\text{K}^+(aq)$	+	e^-
Barium	$\text{Ba}(s)$	$\longrightarrow$	$\text{Ba}^{2+}(aq)$	+	$2e^-$
Calcium	$\text{Ca}(s)$	$\longrightarrow$	$\text{Ca}^{2+}(aq)$	+	$2e^-$
Sodium	$\text{Na}(s)$	$\longrightarrow$	$\text{Na}^+(aq)$	+	e^-
Magnesium	$\text{Mg}(s)$	$\longrightarrow$	$\text{Mg}^{2+}(aq)$	+	$2e^-$
Aluminum	$\text{Al}(s)$	$\longrightarrow$	$\text{Al}^{3+}(aq)$	+	$3e^-$
Manganese	$\text{Mn}(s)$	$\longrightarrow$	$\text{Mn}^{2+}(aq)$	+	$2e^-$
Zinc	$\text{Zn}(s)$	$\longrightarrow$	$\text{Zn}^{2+}(aq)$	+	$2e^-$
Chromium	$\text{Cr}(s)$	$\longrightarrow$	$\text{Cr}^{3+}(aq)$	+	$3e^-$
Iron	$\text{Fe}(s)$	$\longrightarrow$	$\text{Fe}^{2+}(aq)$	+	$2e^-$
Cobalt	$\text{Co}(s)$	$\longrightarrow$	$\text{Co}^{2+}(aq)$	+	$2e^-$
Nickel	$\text{Ni}(s)$	$\longrightarrow$	$\text{Ni}^{2+}(aq)$	+	$2e^-$
Tin	$\text{Sn}(s)$	$\longrightarrow$	$\text{Sn}^{2+}(aq)$	+	$2e^-$
Lead	$\text{Pb}(s)$	$\longrightarrow$	$\text{Pb}^{2+}(aq)$	+	$2e^-$
Hydrogen	$\text{H}_2(g)$	$\longrightarrow$	$2\text{H}^+(aq)$	+	$2e^-$
Copper	$\text{Cu}(s)$	$\longrightarrow$	$\text{Cu}^{2+}(aq)$	+	$2e^-$
Silver	$\text{Ag}(s)$	$\longrightarrow$	$\text{Ag}^+(aq)$	+	e^-
Mercury	$\text{Hg}(l)$	$\longrightarrow$	$\text{Hg}^{2+}(aq)$	+	$2e^-$
Platinum	$\text{Pt}(s)$	$\longrightarrow$	$\text{Pt}^{2+}(aq)$	+	$2e^-$
Gold	$\text{Au}(s)$	$\longrightarrow$	$\text{Au}^{3+}(aq)$	+	$3e^-$

